



Construction process simulation based on significant day-to-day data

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Summary

This paper presents developments to improve the controlling of construction progress in complex building projects by using simulation. Thus it points out the great potential of simulation that arises from identifying long-term consequences at earlier stages. Therewith the controlling and flexibility in case of changed conditions will increase enormously. As basis for simulation models the real-time state of construction has to be captured. In consequence the paper discusses how to combine different controlling tools for gathering construction performance and for deriving on the real on-site status.

The approach is structured into three parts. The definition of data, which are actually needed for evaluating a current on-site status, the instruments that can effectively be used for the data evaluation, and the creation of a structured process model based on the aforementioned aspects. Finally future lines of development of the real time based simulation are discussed.

Keywords: Simulation, optimization, process monitoring, evaluation techniques, day-to-day data

1. Introduction

The presented paper outlines an approach based on accurate day-to-day data for the current project state at any time. These data then facilitate the simulation of possible variations for ongoing optimization. Thus, the critical path monitoring and the flexibility in case of changes will be improved immensely; signs for long-term consequences will be spotted at earlier stages.

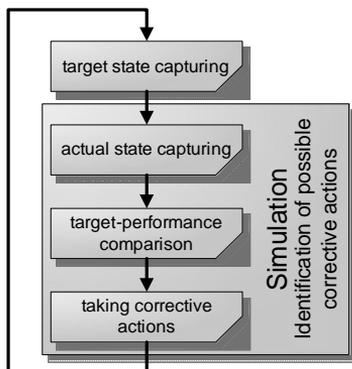


Fig. 1: Simulation in process monitoring

The critical point of the progress monitoring is to capture appropriate signs of actual state, which will necessitate corrective actions. Up to today this depends very much on the competence and experience of the site manager. Particularly the estimation of long-term consequences is a difficult task. As illustrated in Fig. 1, simulation will be utilized for supporting the process from actual state up to the definite decision on corrective actions.

An accurate simulation model requires significant day-to-day data. Thus capturing of the construction progress with sufficient exactness is needed.

For the definition, which data are needed for the description of the on-site status and which instruments are suitable, the different requirements will be discussed. For the identification and analysis of the data needed for monitoring, the real time state of a construction in progress, the construction process will be described and visualized by method of process modelling.

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2. Data sources

Up to now most research projects develop and analyse data gathered from one type of source, for example RFID or laser scanning. But the reality in construction is so various, that no single technique is optimal, and that different techniques of data gathering have to be combined. Thus an appropriate mix of tools for data will be established within the ongoing research project. Therefore parallel to the process modelling, all sources of information are identified, that in total give significant information about the current state of the construction site [1]. Based on this examination the information sources and instruments are methodically compared to each other and interpreted with regard to a specific subsequent processing within the system for capturing the real-time state of construction. In addition a catalogue of typical construction elements is developed, which will answer the question how to capture best different kinds of elements.

The so far developed basics concerning process modelling and data evaluation will be combined into one model. By using process modelling the building progress is structured in events, functions, relations and additional grid points pursuant to the requirements of deadline monitoring and simulation. Thus it defines where and when information should be captured. Now those points will be matched with the possible data sets. Preference is given to real-time data.

Using a sample construction process as test environment, a complete simulation model with different data evaluation and grid points is developed. On this model tests are run with regard to data formats, evaluation intervals and response times. An important aspect is the fast and integrated data handling, which allows daily steering. In everyday construction business this time lap is of particular importance for a daily accurate simulation. Of course, the automatic generation and evaluation of the data is one special aspect.

3. Conclusion/Perspectives

One major objective is to evaluate applications and limits of the presented concept using grid points. A further aspect is the question: How can the evaluated data be implemented in a simulation tool? Using simulation in construction processes, which have been developed at the chair of construction engineering and management at Bauhaus-University Weimar [2], the prototype implementation of different instruments for data generation will be added to the simulation model. The effects of different performances then will be analysed.

Simulation models are suitable for developing construction sequences, as shown in [2]. This approach considers the monitoring aspect of construction sites. Data gathering, data processing and the following steering processes are implemented in the simulation model. It yields information about the importance of precision, velocity, automation, redundancy and significance of data capturing during construction processes. There the results, the advantages, disadvantages, weak points and application limits can be adjusted to different construction conditions. Furthermore the error-proneness can be tested. One aspect is missing data and how the simulation will react in case of uncertainties or, for example, a missing delivery note.

With the knowledge from these simulation experiments the results will be verified on a prototype. Even if the model suggests a complete control of the construction process, the reader should be aware, that construction is far too complex to just rely on the automation. The presented approach is a way to improve the information on ongoing construction sites. It will enable the construction manager to better concentrate on real obstacles, which have not been encountered in advance, and to have better information sources for routine processes to be steered. Thus the time to react will be shortened. Is it then also possible to evaluate effective counteractions by using the simulation tool in combination with real-time data gathering.

4. References

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